gibbs.R

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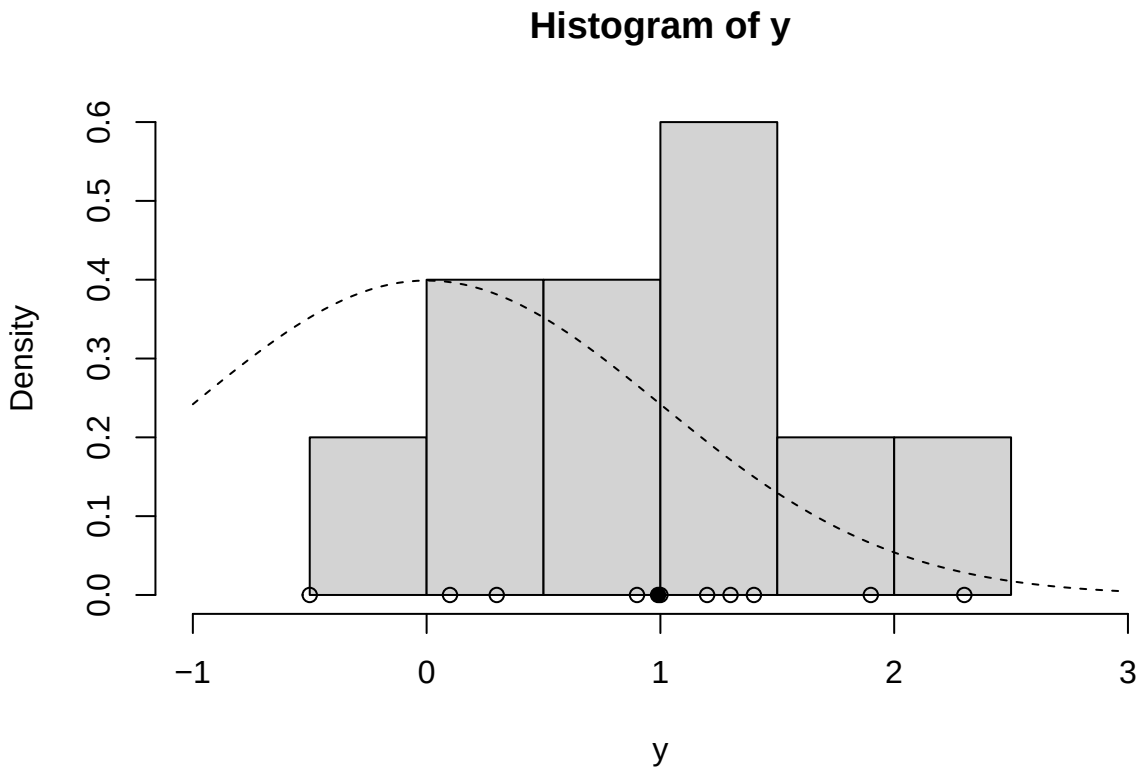
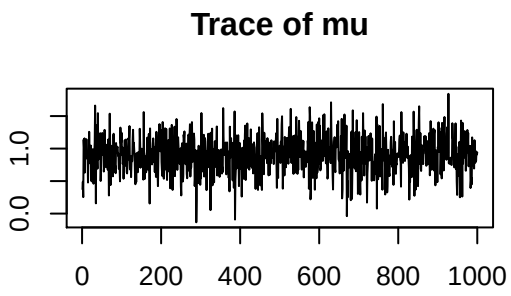
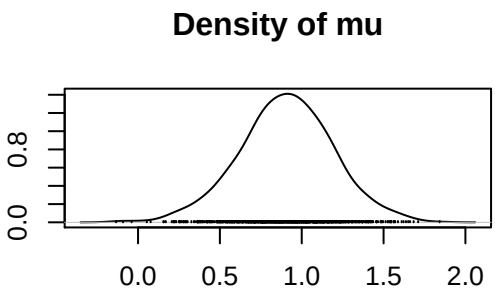
```
library("coda")

update_mu = function(n, ybar, sig2, mu_0, sig2_0) {
  sig2_1 = 1.0 / (n / sig2 + 1.0 / sig2_0)
  mu_1 = sig2_1 * (n * ybar / sig2 + mu_0 / sig2_0)
  rnorm(n=1, mean=mu_1, sd=sqrt(sig2_1))
}

update_sig2 = function(n, y, mu, nu_0, beta_0) {
  nu_1 = nu_0 + n / 2.0
  sumsq = sum( (y - mu)^2 ) # vectorized
  beta_1 = beta_0 + sumsq / 2.0
  out_gamma = rgamma(n=1, shape=nu_1, rate=beta_1) # rate for gamma is shape for inv-gamma
  1.0 / out_gamma # reciprocal of a gamma random variable is distributed inv-gamma
}


gibbs = function(y, n_iter, init, prior) {
  ybar = mean(y)
  n = length(y)

  ## initialize
  mu_out = numeric(n_iter)
  sig2_out = numeric(n_iter)

  mu_now = init$mu

  ## Gibbs sampler
  for (i in 1:n_iter) {
    sig2_now = update_sig2(n=n, y=y, mu=mu_now, nu_0=prior$nu_0, beta_0=prior$beta_0)
    mu_now = update_mu(n=n, ybar=ybar, sig2=sig2_now, mu_0=prior$mu_0, sig2_0=prior$sig2_0)

    sig2_out[i] = sig2_now
    mu_out[i] = mu_now
  }

  cbind(mu=mu_out, sig2=sig2_out)
}



y = c(1.2, 1.4, -0.5, 0.3, 0.9, 2.3, 1.0, 0.1, 1.3, 1.9)
```

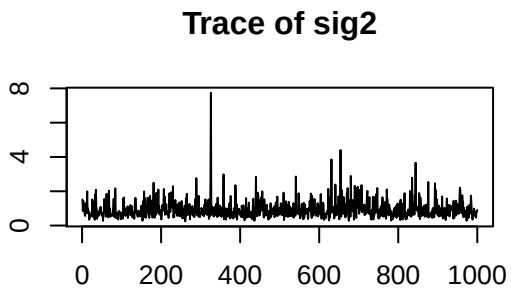
```r
ybar = mean(y)
n = length(y)

## prior
prior = list()
prior$mu_0 = 0.0
prior$sig2_0 = 1.0
prior$n_0 = 2.0 # prior effective sample size for sig2
prior$s2_0 = 1.0 # prior point estimate for sig2
prior$nu_0 = prior$n_0 / 2.0 # prior parameter for inverse-gamma
prior$beta_0 = prior$n_0 * prior$s2_0 / 2.0 # prior parameter for inverse-gamma

hist(y, freq=FALSE, xlim=c(-1.0, 3.0)) # histogram of the data
curve(dnorm(x=x, mean=prior$mu_0, sd=sqrt(prior$sig2_0)), lty=2, add=TRUE) # prior for mu
points(y, rep(0,n), pch=1) # individual data points
points(ybar, 0, pch=19) # sample mean
```

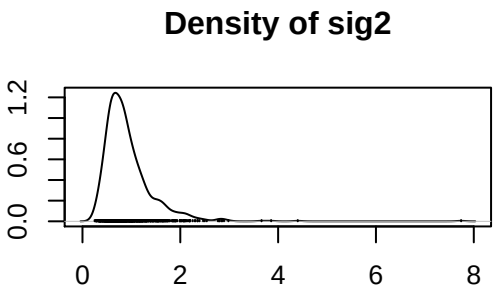



```r
set.seed(53)

init = list()
init$mu = 0.0

post = gibbs(y=y, n_iter=1e3, init=init, prior=prior)
plot(as.mcmc(post))
```










```
summary(as.mcmc(post))
```

```
##
## Iterations = 1:1000
## Thinning interval = 1
## Number of chains = 1
## Sample size per chain = 1000
##
## 1. Empirical mean and standard deviation for each variable,
##    plus standard error of the mean:
##
##        Mean     SD Naive SE Time-series SE
## mu   0.9051 0.2868  0.00907        0.00907
## sig2 0.9282 0.5177  0.01637        0.01810
##
## 2. Quantiles for each variable:
##
##        2.5%    25%    50%   75% 97.5%
## mu   0.3024 0.7244 0.9089 1.090 1.481
## sig2 0.3577 0.6084 0.8188 1.094 2.141
```